Priority 4: Improve ecosystem water quality
Constituent Information
What ecosystem water quality constituent(s) are you targeting?
Water temperature
Summarize how the proposed actions will improve the ecosystem water quality in relation to the target constituent.
The proposed project would create a reservoir with a maximum depth of 275 feet. The new reservoir would allow for a thermocline to form at different times of the year likely ranging from 30 to 50 feet in depth based on the water temperature dynamics observed in the nearby Rollins and Camp Far West reservoirs. Water temperatures below the thermocline are expected to remain colder than both the receiving waters and reservoir surface temperatures. This colder water would provide direct benefits to local fish and aquatic invertebrate communities who rely on these conditions, such as local cold water fish (e.g., trout) that can utilize the reservoir as a large-scale dependable source of cold-water refugia during summer months when water temperatures in the Bear River upstream of the project may rise to inhospitable levels. Benefits to the local cold water fish and invertebrate communities could also have a positive effect to organisms higher on the food chain that rely on these fish and invertebrates for food such as bald eagles and osprey. The proposed project could also release this colder water through the low level outlet of the dam which would help provide similar benefits downstream into Lake Combie. These colder water temperature benefits may also be seen in the water released into the Bear River below Lake Combie.
Does the proposed ecosystem water quality improvement benefit habitats or species life stages? How?
Yes. Colder water temperatures are preferred for resident trout which are present in the Bear river at the proposed project location. Fisheries sampling conducted as part of the Yuba-Bear and Drum-Spaulding FERC relicensings identified both brown and rainbow trout were present in the Bear River at the proposed project location. The anticipated cold water pool created by the reservoir could be utilized by adults and juvenile life stages as they move out of the river habitats when water temperatures become too warm. Colder water temperatures released below Lake Combie could also provide better spawning habitat for trout in that reach of the Bear River.
Additional locations in the application, supporting documentation or attachments (document name, page number, table number, other) where the chemistry, toxicity, and negative effects constituents are described (i.e. Material Safety Data Sheets).
REV 2: Magnitude of ecosystem improvements
What is the expected magnitude of the ecosystem improvement that will address this priority? Magnitude should be expressed as: a) the change from current conditions without the project to current conditions with the project, and b) the change from 2030 conditions without the project to 2030 conditions with the project. How did you estimate this value? If the project intends to benefit multiple constituents, the magnitude of the change in each constituent needs to be provided.
The ecosystem improvement would be realized in the summer and early fall period when the reservoir would be stratified and a cold water pool would be available beneath the thermocline. Based on the water temperature dynamics observed in nearby reservoirs (Rollins and Camp Far West) the anticipated thermocline for the proposed project's reservoir is 30 to 50 feet. Based on the preliminary available area – capacity curve, this would create a cold water pool of approximately 61,700 acre-feet when the reservoir is stratified. This available cold water pool would not exist under current or 2030 conditions without the proposed project since the reservoir would not exist.
Additional locations in the application, supporting documentation or attachments (document name, page number, table number, other) where the magnitude of the ecosystem improvement is described and quantified.
REV 3: Spatial and temporal scale of ecosystem improvements.
What is the geographical extent (e.g. river miles, acres) of the ecosystem improvement that will address this priority?
The proposed project is expected to create a reservoir of approximately 110,000 acre-feet. Considering an average thermocline depth of 30 to 50 feet, approximately 61,700 acre-feet of colder water may be maintained due to the proposed project.
Additional locations in the application, supporting documentation or attachments (document name, page number, figure name or number, other) where the geographical extent of the ecosystem improvement is documented or mapped.
When during the year will ecosystem water quality improvements be provided? How is ecosystem water quality likely to vary

with hydrologic conditions (i.e. among water year types) a) under current conditions with and without the project, and b) in 2030 with and without the project? If the project intends to benefit multiple constituents, provide the timing of water quality improvements for each constituent separately.
The greatest benefit to water temperature would be in the summer and early fall months when surface waters in the Bear River are typically the warmest. The summer is also when reservoirs typically are the most stratified and the greatest difference in temperature is observed between the epilimnion and hypolimnion. The colder water available throughout the hypolimnion would provide refugia for trout and other cold water species during periods of high water temperature elsewhere in the reach below Rollins Reservoir. The cold water releases from the proposed project would also reduce water temperatures in Lake Combie and in the Bear River below Lake Combie during the same time period. The cold water pool would not exist under current or 2030 conditions without the proposed project since the reservoir would not exist, therefore, ecosystem water quality improvements would not be realized without the project.
Additional locations in the application, supporting documentation or attachments (document name, page number, table number, other) where the timing of ecosystem water quality improvements are documented.
REV 4: Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve ecosystem benefits.
Provide additional information on how this ecosystem improvement will be incorporated into the adaptive management and monitoring program. If available, provide examples of objectives, performance measures, thresholds, or triggers that could be used to manage benefits associated with this priority.
During development of the environmental document and permits for the Proposed Project, an adaptive management and monitoring program will be prepared in collaboration with federal, state, and local agencies.
REV 5: Immediacy of ecosystem improvement actions and realization of benefits
Immediacy of ecosystem improvement: Number of months from grant encumbrance until the proposed ecosystem improvement is completed (i.e. the expected timeframe until the improvement is implemented or construction is completed).
Approximately 36 months. It is estimated that the project would take two to three years for construction. Upon completion of construction, the period of time to fill the reservoir is estimated to range up to three years, depending on water year types that occur during the initial fill, the time period to develop a stratified reservoir with hypolimnion and epilimnion would depend upon the time of year and the water year type(s) involved. If initial fill conditions occur during an above normal or wetter water year, a well stratified reservoir with a cold-water pool hypolimnion is predicted to occur in the summer following the first full winter-spring runoff period. Regardless of which combination of water year types that occur during the initial fill period, once the reservoir is filled and the operations have stabilized, the new reservoir would exhibit the predicted ecosystem improvements associated with a cold-water pool in storage.
Additional locations in the application, supporting documentation or attachments (document name, page number, table number, other) where the immediacy timeframe is described and quantified.
Realization of ecosystem improvement: Number of months from the time the ecosystem improvement is completed (i.e. project is implemented or construction is complete), until the benefit associated with this priority can be observed (i.e. when measurable improvements can be observed and quantified)
Approximately 6 to 8 months. The ecosystem improvement of additional cold water availability in the Bear River would be realized in the first summer in which the reservoir has accumulated enough water in storage to stratify, which is estimated to be a minimum of approximately 20,000 ac-ft of useable storage and a water depth of approximately 85 feet. These estimates of stratification at the proposed reservoir are based on water temperature data collected in Camp Far West Reservoir. This initial stratification may occur as early as the first summer after the project is completed depending on the type of water year (wet, above normal) and upstream water operations.
Additional locations in the application, supporting documentation or attachments (document name, page number, table number, other) where the realization timeframe is described and quantified.

REV 6: Duration of ecosystem improvements
How long (number of years) after realization (as calculated under REV 5 above) is the ecosystem improvement expected to address this priority? Maximum is 100 years. Explain how this value was determined and whether the magnitude of the ecosystem improvement is anticipated to change over time.
100 years. The reservoir and related facilities are expected to be permanent and with appropriate maintenance would last for 100 years. For every year that the aforementioned minimum water pool is available, the reservoir would become stratified in the summer and early fall providing a consistent cold water pool. Over time, as air temperature is predicted to increase this cold water pool would likely remain insulated from atmospheric effects. The relatively narrow and deep nature of the reservoir would also lessen the effects of evaporation on the reservoir, providing additional protections to the cold water pool.
Additional locations in the application, supporting documentation or attachments (document name, page number, table number, other) where the duration of the ecosystem improvement is described and quantified.
REV 7: Consistency with species recovery plans and strategies, initiatives, and conservation plans
Does the ecosystem improvement meet any goals or objectives established in existing species recovery plans, initiatives, or conservation plans including but not limited to the NOAA Fisheries Recovery Plan for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead; State Wildlife Action Plan; Central Valley Joint Venture Implementation Plan, San Joaquin County Multi-Species Habitat Conservation Plan and Open Space Plan, Draft Solano Multi-Species Habitat Conservation Plan, East Contra Costa County Habitat Conservation Plan/Natural Community Conservation Plan, Draft Recovery Plan for the Giant Garter Snake, and California Water Action Plan? If so which goals, objectives, or actions will be met? Why?
The 2014 California Water Action Plan was developed to meet three broad objectives: "more reliable water supplies, the restoration of important species and habitat, and a more resilient, sustainably managed water resources system (water supply, water quality, flood protection, and environment) that can better withstand inevitable and unforeseen pressures in the coming decades." A critical element in achieving these objectives is the creation of additional surface storage. As stated in the plan, "The bottom line is that we need to expand our state's storage capacity, whether surface or groundwater, whether big or small. Today, we need more storage to deal with the effects of drought and climate change on water supplies for both human and ecosystem needs." Opportunities for the development of a major on-stream surface storage project in California are limited as evidenced by the fact that it has been 40 years since the last such project was completed. Centennial reservoir presents an ideal opportunity for developing new significant surface storage. The project would be located on a highly regulated reach of the Bear River located between two existing reservoirs: Combie and Rollins located immediately downstream and upstream, respectively, of the Centennial site.
Additional locations in the application, supporting documentation or attachments (page number, table number, other) where the consistency with goals, objectives, or actions from recovery plans, initiative, or conservation plans are discussed.
None
REV 8: Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values
Provide a map that shows the extent of the ecosystem improvement that will address this priority (e.g. river miles that meet the temperature benefits). Provide additional instructions or clarification to reviewers who will be viewing this map (i.e. describe the color and/or label that identifies the spatial extent of the ecosystem improvement). If available, also submit supporting electronic files such as a .kmz file or ArcGIS layer associated with the maps provided.
Figure 1. Approximate River Miles for Water Quality Benefit.
Explain why this location was selected in the context of local environmental conditions and the target constituent(s). Why was this location selected over other potential locations?
The location being evaluated for Centennial Reservoir would effectively work in conjunction with NID's existing Rollins Reservoir to expand the total storage capability in the Bear River watershed. This use would allow additional water to be captured from diversions out of NID's Mountain Division system in the Yuba River watershed, as well as natural runoff in the Bear River watershed (both the runoff in excess of what Rollins Reservoir can store on a seasonal basis as well as the runoff in the sub-basin below the Rollins Dam catchment) for the purpose of maximizing reservoir storage during the winter and early spring runoff period to provide water to customers in NID's lower Bear River watershed service area. Although, the ecosystem

improvements related to water temperature are inherent to project implementation they are not the primary factor in siting the proposed project.
Is the ecosystem water quality improvement location adjacent to, or near, other areas already being protected or managed for conservation values? Explain the proximity of the ecosystem water quality improvement to other areas already being protected or managed for conservation values and any hydrologic connectivity that may occur between these locations.
The proposed reservoir site being considered is not currently adjacent to, within or near other areas protected or managed for conservation purposes.
Additional locations in the application (document name, page number, figure name or number, other) that describe the extent of the ecosystem water quality improvements, the proximity of claimed improvements to other areas already being protected or managed for conservation value, and the degree to which hydrologic connections (if any) occur between claimed improvements and areas already being protected or managed for conservation value.
REV 9: Efficient use of water to achieve multiple ecosystem benefits
If applicable, how will water provided to address this priority be managed? Explain design efficiencies and operational strategies intended to maximize the efficiency of water allocated to ecosystem improvements that address this priority.
The area inundated by the proposed project would be located in a narrow canyon of the Bear River and would result in a deep, narrow reservoir with a low surface area to volume ratio and therefore would be subject to less evaporative losses compared to shallower reservoirs of a similar capacity but with larger surface area, thereby yielding more total water for beneficial uses (cold water) per acre-foot stored. This reservoir configuration would also be more protective of the resulting cold-water pool available during periods of stratification (summer and early fall) due to less wind effects mixing due to a lower surface area to volume ratio. The proposed project would have a static operating pool (no discretionary hydropower generation or flood control operation) which would also help to ensure a reliable cold water pool available during periods of stratification.
Additional locations in the application, supporting documentation or attachments (document name, page number, figure name or number, other) that describe the design efficiencies and operational strategies used to maximize water efficiency under this priority.
Refer to Benefit, Calculation, Monetization, and Resiliency Tab, A.1 Project Conditions and A.2. Preliminary Operations Plan.
REV 10: Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change.
Which environmental uncertainties associated with this priority were considered in the project siting, design, and operation? How were these uncertainties incorporated into project siting, design, or operation? Examples of environmental uncertainties include, but are not limited to: sea level rise, temperature changes, changes in precipitation, landslides, erosion, earthquakes, wildfires, drought events, and flooding events.
As stated above under REV 7 and 8, the area being evaluated for the proposed project is considered a suitable location along the Bear River since it would be located on an already regulated reach of the Bear River between two existing reservoirs. The ecosystem improvements related to water temperature would result from coordination with the resource agencies and preparation and implementation of adaptive management and monitoring programs during development of the Proposed Project.
Additional locations in the application, supporting documentation or attachments (document name, page number, figure name or number, other) that describe and quantify the environmental uncertainties considered in the project siting, design, and operation.